OBJECTIVES OF THE SELENE MULTIBAND IMAGER AND SPECTRAL STUDY OF Dho489. M. Ohtake[1], J. Haruyama[1], S. Mastunaga[2], T. Morota[1], Y. Yokota,[1], C. Honda[1], A. Yamamoto[3], T. Arai[4], H. Takeda[5] and LISM team, [1] Planetary Science Department, Japan Aerospace Exploration Agency (JAXA), 3-1-1 Yoshinodai, Sagamihara, Kanagawa, 229-8510, Japan (ohtake.makiko@jaxa.jp), [2]The National Institute for Environmental Studies (NIES), 16-2, Onogawa,Tsukuba, Ibaraki, 305-8506, Japan, [3]Remotesensing Remote Sensing Technology Center of JAPAN, 1-9-9 Roppongi, Minato-ku, Tokyo, 106-0032, Japan, [4]National Institute of Polar Research, 9-10, Kaga 1-chome, Itabashi-ku, Tokyo, 173-8515, Japan,, [5]Research Inst., Chiba Inst. of Technology, 2-17-1 Tsudanuma, Narashino City, Chiba, 275-0016, Japan.

Introduction: The Lunar Imager/ SpectroMeter (LISM) is an instrument being developed for the SELENE project that will be launched in 2007. LISM consists of the three subsystems, Terrain Camera (TC), Multiband Imager (MI), and Spectral Profiler (SP). The sub-systems share some components and electronics [1].

MI is a high-resolution multiband imaging camera consisting of two visible and near infrared sensors. MI takes push-broom imaging data by using selected lines of area arrays. The spectral band assignments are 415, 750, 900 and 1000 nm for visible and 1000, 1050, 1250 and 1550 nm for near infrared. The spatial resolution of visible bands is 20 m, and that of near infrared bands is 62 m from the 100 km SELENE orbital altitude. Specification of MI is shown in Table 1.

Manufacturing and integration of MI flight model have been completed and pre-flight test as SELENE satellite is underway. Measurements of MTF, viewing vector, sensor linearity, (brief) stray light and electrical noise level were carried out after the MI integration. Measured data indicate that MI will provide sufficient MTF, low noise and low stray light spectral imaging data just as estimated in the MI designing phase [2]. Also as a result of continuous effort, intensity of cross talk among spectral bands is kept especially low.

Table 1 Specification of LISM/MI.

	VIS	NIR
Focal length	65 mm	65 mm
F number	3.7	3.7
Field of view	11 deg	11 deg
Spatial resolution	20 m	62 m
Swath width on ground	19.3 km	19.3 km
Detector	2D CCD (1024 x1024 pixel)	2D InGaAs (320 x 240 pixel)
Pixel size	13 x 13 µm	40 x 40 µm
Detector cooler	N/A	N/A
Number of band	5	4
Band assignment	415 +/- 10 nm 750 +/- 5 nm 900 +/- 10 nm 950 +/- 15 nm 1000 +/- 20 nm	1000 +/- 15 nm 1050 +/- 15 nm 1250 +/- 15 nm 1550 +/- 25 nm
Quantization	10 bit	12 bit
S/N	> 100	> 300
MTF	> 0.2 @ Nyquist	> 0.2 @ Nyquist
Integration times	5.33, 2.66 and 1.33 msec	26.4, 13.2 and 6.4 msec
Data compression	DPCM (loss-less)	N/A
Compression rate	< 80%	-
Solar elevation angle in operation	30-90 deg	
Data amount	49.0 Gbit/day	

We will observe the global mineral distribution of the lunar surface in nine band images of MI.

Objectives of the MI: One of the most important scientific goals of MI is to search for most primitive lunar crustal materials such as magnesian anorthosites, that is suggested to be located in lunar far side from resent lunar meteorite studies [3] [4] by utilizing MI's high spatial resolution and high S/N. MI's high spatial resolution will also enable us to investigate small but scientifically very important areas such as crater central peaks and crater walls. Investigations of such small areas will help answer current questions such as the existence, chemical composition and source of olivine at the central peaks of some craters. The advantage of MI for this aspect is that we can remove topographic effect, which causes false reflectance values seen in the crater wall and crater central peak, by photometric correction with detailed topography. Digital terrain model is derived from TC stereoscopic images, or MI band sets, which has 10.5 degree in parallax. Low stray light (both spatial and spectral) property is also very effective to investigate dark area within bright region such as highland mare.

Data Analyses Plan: On-ground data processing systems of LISM have been established as a part of SELENE Operation and Analyses Center (SOAC) which is located in a JAXA Sagamihara Campus. Data storage and distribution system for the whole SELENE mission data is also installed in SOAC.

On-ground data processing flow of MI is prepared as shown in Fig. 1. We are going to produce Level 2A, Level 2B, Level 2C and MAP product from MI data and it will be distributed to the LISM and SELENE team and then to the public according to a SELENE data opening plan.

Two characteristic data processing algorithms are used for MI data. One is an algorithm to do a frame transfer correction of MI visible data in which data correction using different band images are required because MI uses selected lines (each line makes different band image) of area arrays and exposure during data transfer of CCD occurs under different wavelength filters. Another is an algorithm in a geometric correction in which an option can be selected to use topographic information derived by MI itself or TC. And for photometric correction we are going to adopt photometric function used in [5] during our initial data processing period to compare MI data to Clementine UV/VIS camera images.

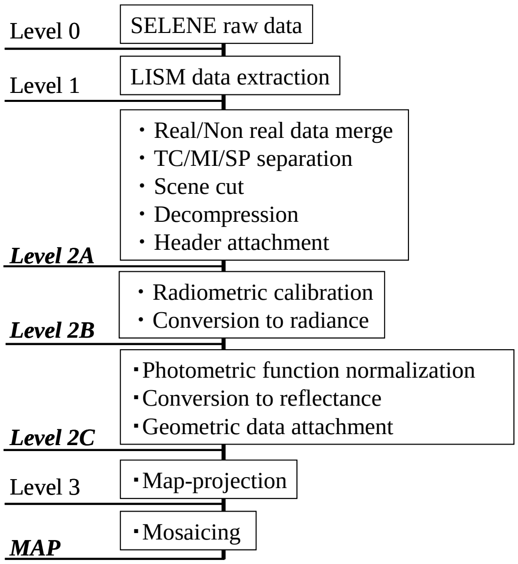

Fig. 1 On-ground data processing flow of MI. Processing levels shown in italic are going to be produced.

Spectral Study of Dho489: Recent study [4] of Lunar meteorite Dho489 shows that it contain anorthositic clast with more Mg-rich mafic minerals than that in FAN samples and it probably came from far side of the moon. We do not know if such magnesian anorthosites exist in certain amount of quantity in the far side of the moon at this moment but if it is it will be able to give constraints to the mechanism of crustal formation and the scale of the lunar magma ocean. Therefore one of the SELENE MI objectives is to explore magnesian anorthosite rocks.

To achieve that goal we study reflectance spectra of Dho489 with typical Apollo highland samples to establish analytical methods to identify magnesian anorthosite using SELENE MI/SP spectral data.

We selected Apollo 60025 as ideal pure FAN endmenbers and 67235 as mixture of Mg-rich mafic rock and FAN materials to compare to the Dho489. We measured bidirectional reflectance spectra of Dho489 (from 300 to 2500 nm at i=30 and e=o, crushed and sieved to 75 ～105 μ m) by MIRAI (Mineralogical Reflectance Analyses Instrument) at JAXA and also measured Apollo 60025 and 67235 rock chip samples by Reflectance Analyses Instrument at Tokyo University. Chemical compositions of minerals were studied by a JXA-8200 electron probe microanalyzer (EPMA) at the National Institute of Polar Research (Tokyo). Curve fitting calculation using Modified Gaussian Model (MGM) [6] were applied to the derived sample spectra to understand the relation between the reflectance spectra and the mineralogy of the samples.

Results (Fig. 2) show preliminary results of our study to establish analytical methods to identify magnesian anorthosite from SELENE MI/SP spectral data. It indicates efficacy of near 2 μ m bands to distinguish Dho489 from Apollo 60025 and 67235 samples but more work is required to apply real remote sensing data such as to consider difference between lunar meteorite and real lunar surface (weathered lunar regolith).

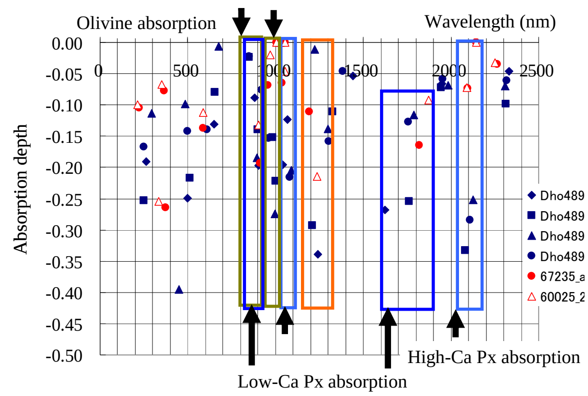

Fig. 2 MGM curve fitting results of Dho489, Apollo60025 and 67235.

References: [1] Ohtake M. et al. (2002) *ISTS*, k-27p. [2] Kodama S. et al. (in prep). [3] Takeda H. et al. (2004) *LPS XXXVI*, Abstract # 1222. [4] Takeda H. et al. (2006) EPSL, 247, 171 – 184p. [5] McEwen A. et al. (1998) *LPS XXIX*, Abstract # 1466. [6] Sunshine J. *et al.* (1990) *J.Geophys. Res.*, 95, B5, 6955-6966.